Fish Transport Techniques in Common Use at Salmonid Enhancement Facilities in British Columbia

B.G. Shepherd and G.F. Hartman

Resource Enhancement Branch
Department of Fisheries and Oceans
Vancouver, B.C. V6H 3R6

August 1987

Canadian Manuscript Report of
Fisheries and Aquatic Sciences
No. 1946

Fisheries and Oceans Pêches et Océans

Canada

88-01022/

Canadian Manuscript Report of Fisheries and Aquatic Sciences

Manuscript reports contain scientific and technical information that contributes to existing knowledge but which deals with national or regional problems. Distribution is restricted to institutions or individuals located in particular regions of Canada. However, no restriction is placed on subject matter, and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Manuscript reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1–900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 901–1425 were issued as Manuscript Reports of the Fisheries Research Board of Canada. Numbers 1426–1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Manuscript reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Les rapports manuscrits contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui traitent de problèmes nationaux ou régionaux. La distribution en est limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports manuscrits peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports manuscrits sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros 1 à 900 de cette série ont été publiés à titre de manuscrits (série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés comme manuscrits (série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros 901 à 1425 ont été publiés à titre de rapports manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 sont parus à titre de rapports manuscrits du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 1551.

Les rapports manuscrits sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

Canadian Manuscript Report of
Fisheries and Aquatic Sciences 1946

August 1987

FISH TRANSPORT TECHNIQUES IN COMMON USE AT SALMONID ENHANCEMENT FACILITIES IN BRITISH COLUMBIA

by

B.G. Shepherd and G.F. Bérézay

Resource Enhancement Branch
Department of Fisheries and Oceans
555 West Hastings Street
Vancouver, B.C. V6B 5G3

© Minister of Supply and Services Canada 1984
Cat. No. Fs 97-4/1946 ISSN 0706-6473

Correct citation for this publication:

Shepherd, B.G, and G.F. Bérézay. 1987 Fish transport techniques in common use at salmonid enhancement facilities in British Columbia. Can. MS Rep. Fish. Aquat. Sci 1946: 35 p.

CONTENTS

Abstract/Résumé iv

Preface v

Introduction 1

Equipment

- Truck tanks 1
- Plastic bags 3
- Aircraft transport 4

Procedures

- Preparation 5
- Loading 6
- Transport 9
- Release 10

Acknowledgements 11

References 12

Photographs 13

Appendix (Transport of live fish on B.C. Ferries) 29

ABSTRACT

Shepherd, B.G., and G.F. Bérézay. 1987. Fish transport techniques in common use at salmonid enhancement facilities in British Columbia. Can. MS. Rep. Fish. Aquat. Sci. 1946: 35 p.

The equipment and procedures used at British Columbia's enhancement facilities to transport juvenile and adult salmonids are reviewed. The three main techniques used in British Columbia -- truck tanks, plastic bags, and aircraft transport -- are detailed with respect to recommended equipment and procedures. Procedures are separated into those relating to trip planning as well as loading, transport and release of fish. Generally in British Columbia, maximum loading rates for adults have ranged 0.5 - 1.0 kg/litre for trips lasting a few minutes, to 0.1 - 0.4 kg/litre (depending on the species) for trips of 15 min or more; actual loading rates for juveniles have ranged from 0.05 - 0.33 kg/litre (depending on a number of factors).

RÉSUMÉ

Shepherd, B.G., and G.F. Bérézay. 1987. Fish transport techniques in common use at salmonid enhancement facilities in British Columbia. Can. MS. Rep. Fish. Aquat. Sci. 1946: 35 p.

Les auteurs font un examen de équipements et procédures utilisés dans les installations de mise en valeur de la Colombie-Britannique pour le transport des salmonidés juvéniles et adultes. Les trois principaux types d'équipements et de procédures recommandés pour le transport -- réservoirs sur camion, sacs de plastique et aéronefs - sont décrits de façon detaillée. Les procédures sont traitées en deux groupes: celles ayant trait à la planification des déplacements et celles touchant le chargement, le transport et la mise à l'eau des poissons. De façon générale, les taux de charge maximums des adultes ont varié de 0,5 - 1,0 kg par litre pour les déplacements de quelques minutes à 0,1 - 0,4 kg par litre (tout dépendant de l'espèce) pour les déplacements de 15 minutes ou plus. Les taux de charge utilisés pour les juvéniles se situaient entre 0,05 à 0,33 kg par litre et étaient fonction de divers facteurs.

PREFACE

The framework for this report was taken from a chapter on transport of fish, contained in a proposed salmonid hatchery manual for British Columbia. The original draft of this manual was written by W.A. Kennedy and W. Griffioen under contract to the Department of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C.

We were asked to revise and update this chapter in 1983. Although we completed the revision of this chapter, support for completion of the Manual was withdrawn. Subsequently, we decided that the revised chapter should be issued as a separate publication, given the interest expressed by various people in this subject. Recently, another revised chapter on hatchery emergency procedures was issued as a paper (Shepherd and Morris 1987), for similar reasons.

Trade names mentioned in this report are for information purposes only, and does not imply endorsement of the products by the Department of Fisheries and Oceans.

INTRODUCTION

> Newly hatched fry can with special care and constant personal attention be conveyed for journeys of twelve to twenty-four hours without serious loss; but to ensure the best results all young fishes should be planted within as few hours as possible after leaving the hatchery. If planted within one or two hours there need be no loss by death (really asphyxia) and if within 6 or 8 hours the results will be highly favourable unless the weather be abnormally warm and the exposure prolonged. Fry will survive the jolts and concussions, the heat and water changes involved in a journey of 20 to 24 hours as I can testify, for I have conveyed cans containing a total quantity of several hundred thousands of salmon-trout or great lake trout fry (8 to 10 days old) a journey of 28 hours (including express wagon, three separate railway journeys, transit across a river by scow, and a rough journey of 2 or 3 hours over a country road) without losing more than 20 to 30 per cent of fish, those surviving being very lively and vigorous. Yet, it must be confessed that young fish even if they live, must be weakened, perhaps, permanently affected by such trying journeys. When critics say: "Your government officers brought a lot of young fish, but 20 per cent of them were dead." My reply is "It is a surprise that 100 per cent were not dead, after such a trying journey." (Prince 1904)

Eighty years later, the journeys are not so trying, nor are dead or stressed fish as accepted. Most of the improvement is due to better transport vehicles and access, although this can be offset by the use of a central hatchery to service a wider geographic area. For example, the Quesnel Hatchery at Likely, B.C. serves five systems that are up to 200 air km and 450 road km distant. Consistent success in moving fish requires good equipment, careful planning and constant vigilance.

EQUIPMENT

The type of equipment used can vary widely, from custom-built tank trucks dedicated to fish transport, to plastic bags in cardboard boxes. British Columbia hatcheries most often use one of three techniques:

(1) TRUCK TANKS

Portable tanks can be mounted singly on a 3/4-ton pickup truck, or grouped on a 5-ton flatdeck truck or fifth-wheel trailer. These tanks can be round and made from wood, aluminum or stainless steel, but they are most often rectangular in shape and made from fibreglass (reduces waste space in loading and easier to insulate and repair). Fibreglass tanks may be cheaper to fabricate than

aluminum ones, particularly if a double-wall insulated style is desired. However, fibreglass is not as strong, is far more prone to leakage, and there are fewer fabricators in B.C. than for aluminum (W. Foye, pers. comm.). Tank sizes normally range from 570 litres (150 gal) to 2270 litres (500 gal).

The tank should be insulated, particularly if transport during warm weather is contemplated. An 8-10 cm layer of dense, closed-cell foam will limit the temperature rise to 1°C when air temperatures are 0-15°C. Tanks usually are sloped both to the center of the tank and to the outlet, to aid in the movement of fish out of the tank. Tanks normally are fitted with lids to prevent loss of fish and water during transport. A large (60 x 120 cm) lid is a must when transporting adults, and hinging the lid in the middle improves access. Foam gaskets on the underside of the lid will help to reduce water loss. A drain valve 10-15 cm in diameter should be positioned at the very bottom of the tank to allow complete drainage of juvenile fish and water. There should be a sliding gate covering the drain on the inner wall; this gate should be fish-tight but does not have to be water-tight, as the outer flange of the drain normally has a water-tight cap to prevent water loss during transport. The outer flange of the drain valve also should be able to be securely coupled to a hose, pipe or flume to facilitate release of fish. It is important to ensure that the length of hose carried is sufficient to reach the release site. A variety of materials are used; rigid-walled hose is most common, but vinyl or light polyethylene hose, PVC piping, and aluminum or stainless steel flumes are used depending on circumstances. For instance, collapsible hose is useful where storage space is limited, and flumes are more appropriate for adult fish.

Where the transport and quick release of large numbers of adult fish is contemplated, a dual-purpose outlet could be considered. A prototype with a 30 x 30 cm end-opening gate for adults, incorporating a 10 cm diameter coupling for juveniles, was tested recently at the Inch Creek Hatchery; release time was approximately one minute for 100 female chum (W. Foye, pers. comm.; See Photos 15A - 15F). this hatchery currently is having a 2270 litre (500 gal) tank fabricated with a 30 x 60 cm end-opening gate.

A smaller (usually 5 cm diameter) valve often is located off to the side of the release outlet. This valve goes into a screened sump on the inside of the tank. The valve can be used to drain off excess water, and to exchange water by pumping; in the latter case, excess water exits by overflowing through the air outlets on the top of the tank.

There must be some means of continually adding oxygen to the water in the tank to replace the oxygen used by the fish. One way is to draw off water from the bottom of the tank, pump it through a venturi where air is entrained, and spray it back into the tank above the water surface. A portable compressor also can be used to provide aeration. However, it is most common to carry bottles of compressed air and oxygen. The use of compressed air alone requires a high rate of delivery to maintain oxygen levels above 80% saturation. The use of oxygen alone reduces the delivery rate, but it is difficult to keep oxygen levels from supersaturating (levels of 150-200% are not uncommon). Conditions of

supersaturated oxygen can stress juveniles due to gill irritation and oxygen toxicity.

The recommended aeration system employs two separate lines, one for oxygen and one for compressed air. Each system must have its own regulator to ensure control. This dual system allows control of oxygen supersaturation, presumably due to the air bubbles absorbing some of the oxygen and expelling it to the atmosphere. The compressed air or oxygen can be introduced at the bottom of the tank through carborundum airstones or through vinyl tubing with numerous holes punched in it, but preferably through micropore tubing. The general idea is to release the maximum number of smallest bubbles possible. Placement of the aerators should take tank circulation and fish behaviour into consideration, in order to avoid "pile-up" of fish in the tank. Protection of supply lines, tubing and airstones is particularly important when transporting adult fish, as they are capable of doing considerable damage. The recommended set-up uses tubing that is firmly attached to the tank bottom in a pattern of sinuously-connected parallel legs. The tubing should be covered with a perforated screen to prevent dislodging. This configuration minimizes dead spots and encourages the fish to utilize the full water column. An alternative approach is to attach the tubing to a removable frame. With this system, the frame is covered with a perforated aluminum sheet only during the transport of adults; the frame is left exposed during the transport of juveniles, and lifting lines are attached to the frame to ensure fish are not trapped by the frame during release. Tanks should be fabricated with a permanent passageway for air lines, running from the top of the tank to an exit inside the tank near its bottom, below the perforated floor if used.

An insulated tank will usually keep temperatures low enough (5-7°C is preferred) on a short trip. It is also helpful to choose a time when air temperatures are low. For longer trips, ice is often used. However, one must ensure that the ice is not contaminated (eg. made from chlorinated domestic water); if there is any doubt, the ice should be carefully sealed in heavy plastic bags. Trucks that regularly haul fish for long distances can be fitted with mechanical refrigeration equipment for cooling the water, but such technological complexity should be avoided if at all possible.

(2) PLASTIC BAGS

Small lots of fish can be transported very simply using this technique. Plastic bags of 4-mil polyethelene with a capacity of 12-24 litres are used. Two bags are used, one inside the other. The inner bag is filled 1/3 full with water and fish, then oxygen is bubbled into the water through a flexible hose until the upper part of the bag is inflated. When well inflated, the bag is quickly sealed with a twist knot and a rubber band. Ice cubes are put between the inner and outer bag to keep the water cool, and the bags are put into a cardboard box for support. An alternative method substitutes the use of a 23 litre (5 gal) plastic bucket in place of the outer bag (D. Buxton, pers. comm.). The bucket is filled with about 8 cm of water and frozen, then the bag containing water and fish is inserted in the bucket. This provides additional protection against bag punctures, as well as a convenient means of cooling.

For a 12-hour trip, an accepted loading rate is 50 grams of fish per litre of water. However, it may be possible to extend the duration of the trip and increase the loading rate if zeolites, buffers and bactericides are added to prevent metabolite and bacterial build-ups. Amend et al (1982) tested such a combination of additives on common aquarium species of fish, and found they could safely double or triple loading densities and trip durations. Further testing with salmonids is necessary before using such additives.

(3) AIRCRAFT TRANSPORT

Stocking of fish from fixed-wing aircraft has become much less common with the advent of helicopters. The use of helicopters allows greater flexibility and accuracy in releases. At present, there are two main types of containers used.

The first type is a monsoon bucket normally used for fire-fighting. These have approximately 400 litres of usable capacity for fish transport (capacity is normally limited by the lifting capacity of the helicopter, generally about 400 kg). There are several types of monsoon buckets available, with some types more suitable for certain operations than others. The rigid-wall fibreglass or aluminum Chadwick bucket is preferred for transport of adults and long fry hauls. The collapsible fabric-and-metal-frame Hawkins-Power bucket is easy to transport between jobs by helicopter, and is useful for juveniles especially when there is no ground crew at the release site to aid in dumping the bucket. The Griffith polymer bucket is not recommended because of the instability of its tall shape and attendant difficulties in loading. Where the bucket will be emptied manually by a ground crew, a tapered bottom section aids in overturning the bucket and ensuring all fry are dumped, as well as making it easier for the pilot to refill the bucket from a stream without assistance.

The second type, recently developed by the B.C. Ministry of Environment and Parks for scatter-release of steelhead fry (Larson 1984), is designed to be suspended from a Bell Long Ranger helicopter on a 30 m line. The aluminum container is composed of 10 22-litre compartments, each separately hinged and controlled by solenoids from a hand-held control box inside the helicopter.

Except for trips lasting under five minutes, aeration is recommended. This is normally accomplished with the use of a 1.1 m^3 (40 ft^3) medical air or oxygen bottle strapped to the bucket and hooked up to an airstone or perforated tubing attached to the bottom of the bucket. The use of a locking lid on the bucket minimizes the chance of accidental dumps and reduces water loss. Where juveniles are being released using a bottom-dumping bucket controlled by a 24V solenoid switch in the cockpit[a], a clear plexiglass lid will allow the pilot to check the fish during transit, and to verify that the bucket opens and closes. Where adults are being airlifted, stronger, light-tight lids are advisable.

---

[a] Most helicopters now have a built-in switch that can be used for this purpose, but it is advisable to double-check that the machine has one before committing to its charter.

Also it is helpful when transporting adults to have a portable water pump with a flexible fire hose and right-angle nozzle attached to it. The pump can be left running at the loading site, and the nozzle can be inserted through a cut-out in the lid to top off and ensure continuous water flow into the bucket until lift-off.

PROCEDURES

PREPARATION

As Westers (1981) pointed out, fish transport often is the final activity undertaken in the hatchery program and, without meticulous planning, it is possible to destroy a significant portion of the year's hatchery production in this one operation.

Prior to starting any preparations, a fish transport permit must be applied for both freshwater and saltwater destinations two months before the date of the proposed transplant. Blank forms can be obtained from Ms. D. Kieser, Transplant Committee, Pacific Biological Station, Nanaimo, B.C. V9R 5K6.

Vehicles and all associated transport equipment should be serviced and tested in advance of transport, and the route should be carefully planned and test-driven to ensure access to the release site and minimize stress on the fish. Routes involving travel on ferries can require a special letter of permission to allow the aeration system to remain running during the ferry ride (see Appendix).

The transport system and all support items which make contact with the water (eg. aerators, release hoses, dipnets, boots, etc.) must be thoroughly disinfected before use. Leitritz and Lewis (1976) recommend using 15 g/100 litres (2.0 oz. dry wt/100 gal U.S.) of HTH (70% available chlorine) to reach a level of 200 ppm or greater for at least 30 min. The pH of the water will normally be above 6.0, and thus will require the addition of 8 ml/100 litres (1 U.S. fluid oz/100 gal U.S.) of glacial acetic acid to properly activate the chlorine. Fill the tank with water first, then add the acetic acid and mix; the HTH comes last. DO NOT ADD THE ACETIC ACID TO THE DRY HTH. Run all pump or spray systems during the exposure period to ensure complete disinfection. Exercise caution in disposal of this solution, as it is toxic to fish. Normally the simplest procedure is to waste it onto dry ground, well away from any fish-bearing waters. If there is any chance that the solution might enter a water course, then the chlorine must be neutralized before it is dumped. Piper et al (1982) recommend use of 1.5 g/litre of sodium thiosulphate to neutralize chlorine solutions 200 ppm in strength. Neutralization is checked with starch-iodide chlorine test paper or with orthotolidine (turns reddish brown or yellow in the presence of chlorine). The system then should be thoroughly flushed before loading fish.

The water temperatures at both the hatchery and the release site should be monitored. Temperature differences of 2-3°C are tolerable, but greater differences are likely to stress the fish. If the difference is greater than 2-3°C, thought should be given to altering the release date or, where possible, acclimating the fish at the hatchery to the release site's temperature over a period of several days. The use of lower temperatures during transfers of normal duration will not affect acclimation (Kennedy 1978).

LOADING

Except where cannibalism or eye-picking problems occur, juvenile fish should be starved for two days before loading to avoid having the water fouled by feces and reduce ammonia build-up during transport (approach this practice with caution). In the past, it has been suggested that fish be crowded by screens into a small part of their raceways to accustom them to being crowded. The benefits of this procedure now are in doubt. The fish should be in good health, and should not be smolting. The latter requirement is somewhat impractical, in that this is when most juveniles are moved in the federal hatchery system. However where it is possible to move fish earlier, do so.

Fish are transferred into the transport container in various ways. The most common method with small numbers of fish is to crowd the fish using screens or nets into a small section of the holding or rearing container, then to dipnet and bucket the fish into the tank. With large numbers of juveniles (ie., over 100,000), commercially-available fish pumps are recommended; use of dipnets and buckets results in long loading times and heavy stressing of the juveniles prior to transport. A fish pump in good order can load 500,000-600,000 fry in 30-45 minutes with little mechanical injury. With small numbers of adults and where there is only foot access, fish are handled on an individual basis. For transfer trips lasting only a few minutes, adults have been carried in canvas stretchers or inner tube sections with closed ends; four litres of water per fish is a rule of thumb for this situation. If the transfer takes longer than a few minutes, backpacks with 20 litres of water per adult have been used. More recently, the use of rigid transport tubes has been preferred, as they minimize handling and mechanical damage. These tubes normally are made from cylindrical or oval aluminum pipe, with one end welded shut and a hinged door at the other end. The door has a gasket to retain water and is held shut with a rubber bungee cord. Some facilities leave the fish in these tubes inside a larger tank, to aid in their transfer upon arrival at the hatchery. Ideally, fish should be allowed to transfer by swimming; this method can be used only where the facility has been planned with an access ramp at the end of the pond, such that the top of the tank is below the water level in the pond. The importance of avoidance of physical damage to adults increases with the length of the holding period required (ie., 1-3 months for some chinook stocks).

It is important to reduce stress during loading. The loading operation should not be hurried. Loading excites the fish and they use much more oxygen than usual immediately after loading. For this reason, aeration is especially important during loading and for about an hour after. If feasible, water should run into the tank and overflow for a time after loading if there is no control

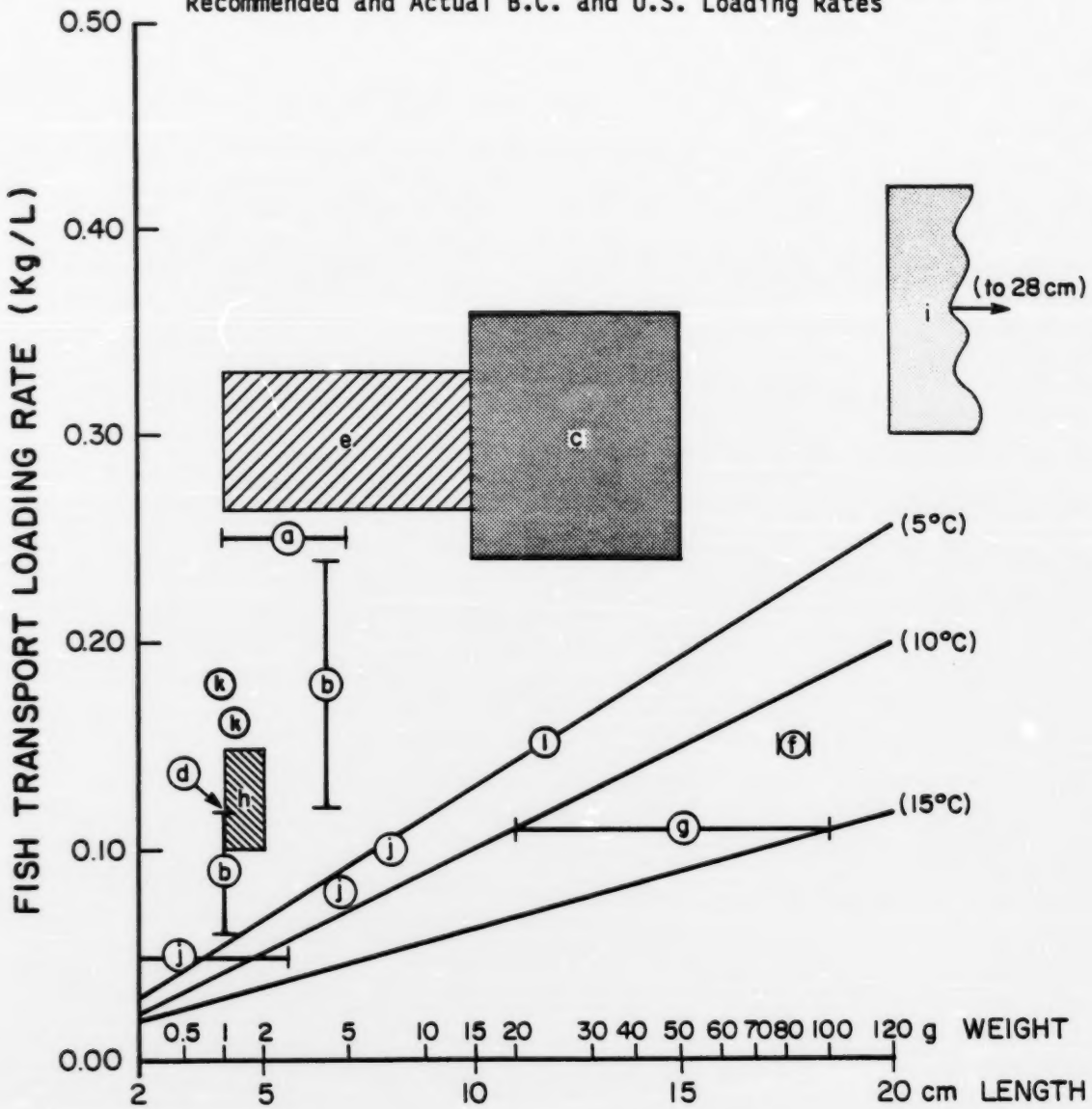
of oxygen level. When compressed oxygen is used, it is normal procedure to charge the transport tank with oxygen to the 135% saturation level at loading. As the fish calm down after loading, the amount of pure oxygen required is reduced and the delivery rate can be adjusted to maintain 80%.

The number of fish that can be carried in a given tank depends on several factors. The higher the temperature, the smaller the fish, and the longer the trip, the less the weight of fish that can be moved successfully. Hatchery personnel can modify loading rates as they gain experience. Fig. 1 provides safe theoretical carrying capacity curves for juvenile salmonids as proposed by Westers (1981), with various B.C. experiences overlaid on them. As Westers emphasizes and the B.C. data tend to confirm, these curves are conservative and most likely can be exceeded in most situations. Piper et al (1982) recommend that, for each 1°C rise in temperature, the load should be decreased 9.5%.

During Conuma Hatchery operations (B. Anderson, pers. comm.) it was observed that chum salmon fry loaded at $\geq$ 0.2 kg/litre were disoriented upon release into quiet water; some swam into the current, while others dove to the bottom or swam into shore. It took about 15 minutes to establish schooling and downstream migration behaviour at these higher densities, whereas these behaviours were immediate at densities $\leq$ 0.2 kg/litre.

Transport of adults in B.C. to date has gone one of three ways, none of which has required rigorous definition of loading rates. The first way has involved trips of some hours, but too few fish to worry about exceeding the transport tank's carrying capacity (eg. transport of wild steelhead captured for hatchery broodstock). The second way involves trips of only a few minutes duration for large numbers of fish. A good example of the latter is the Pinkut Creek sockeye airlift, where 10,000 fish/day are transported in monsoon buckets. Each trip routinely takes two to four minutes with 100-130 2.3 kg sockeye in 450 litres of water without aeration (C. Harrison, pers. comm.). The third and most common way is transport of moderate numbers of fish in truck tanks. One example of this last technique is the transport of chinook at Vancouver Island facilities; for trips of 15-20 minutes, 20-25 chinook averaging about 11 kg have been carried in a 2250 litre tank with and without aeration (Lepage MS 1984). This loading is considered by staff to be "light". A second example using other species and "heavy" loading is from the Pallant Creek Hatchery located in the Queen Charlotte Islands; for trips of 10-15 minutes, up to 50 8-kg chum or up to 35 8-kg coho have been safely carried in an aerated 1125 litre tank (P. Slobodzian, pers. comm.). At the Inch Creek Hatchery in the lower Fraser Valley, 250 kg of adult chum salmon are carried for 1-2 hours (including loading time) in aerated 965 litre tanks; 480-600 kg have been carried in 2500 litre tanks in the same situation (W. Foye, pers. comm.). In general, it would appear that loading rates of 0.5-1.0 kg/litre should be considered as the maximum for trips lasting a few minutes, and rates of 0.1-0.4 kg/litre (dependent on the species) could be used for trips lasting a quarter of an hour or more.

Figure 1. Theoretical Loading Curves From Westers (1981), Compared to Recommended and Actual B.C. and U.S. Loading Rates



NOTES:

CODE	SPECIES	STOCK	°C	TRIP DURATION	DATA SOURCE
a	Chinook	Quesnel	5-6	8 hr	G. Bérézay DFO (unpub.)
b	Chinook	USA-Various	'normal'	not specified	Piper et al (1982)
c	Coho	USA-Various	'normal'	not specified	Piper et al (1982)
d	Chum	Conuma	6	4-5 min	B. Anderson DFO (pers comm)
e	Salmon	General	3	20-30 min	Kennedy (1978)
f	Rainbow	Domestic	?	< 8 hr	B. Ludwig BCMOE (pers comm)
g	Steelhead	Various	?	8-12 hr	B. Ludwig BCMOE (pers comm)
h	Steelhead	Various	?	4-5 hr (air)	B. Ludwig BCMOE (pers comm)
i	Trout	General	'ideal'	8-10 hr	Piper et al (1982)
j	All Spp.	General	10-15	12 hr	Kennedy and Griffioen (unpub)
k	Chum	Inch	7.5	2-2.5 hr	W. Foye (unpub)
l	Coho	Inch	7.5	2.5-3 hr	W. Foye (unpub)

Piper et al (1982) recommend that loading densities be routinely calculated and reported in the following manner:

$$\text{Loading density (kg/litre)} = \frac{\text{kg of fish}}{\text{tank capacity (litres)} - \text{water displaced by fish (litres)}}$$

Juvenile fish preferably should be weighed as they are loaded. An alternative method is to note the amount of water that they displace when loaded into the transportation tank. For example, suppose that the average weight of the fish to be moved is 2 g, and that a loading rate of 50 g per litre has been decided on, and that the transportation tank, which has vertical sides, holds 1200 litres when the water in it is 90 cm deep, the usual depth. Then the weight of the fish to be loaded is 50 X 1200 = 60,000 g. Since the normal specific gravity of living salmonids is the same as water, 60,000 g of fish must displace 60,000 g of water or 60 litres of water. To increase the water level in the tank by 1 cm requires that 1200/90 = 13.33 litres of water be added, so when 60 litres of water (or 60,000 g of fish) are added, the level must rise by 60/13.33 = 4.5 cm. Therefore, if the tank is filled to the 80 cm level initially, and if "dry" fish are then added until the water in the tank is 80 + 4.5 = 84.5 cm deep, there should be close to 60,000 g of fish (30,000 fish) in the tank. The tank can then be topped off. This method greatly reduces handling of the fish and allows use of a fish pump.

If the sides of the tank are not perpendicular, the amount needed to fill the tank to a given level can be found by filling it with a known quantity of water. Depths corresponding to specific volumes of water can be marked on the tank or on a measuring stick.

Adding common salt (sodium chloride) to the transport water to make a 0.5% solution seems to lessen mortalities through reduction of osmoregulatory demand. The process of aerating water in which fish are being transported causes copious foaming at the water surface. Sometimes anti-foaming agents are used to control foaming. Use of MS-222 for sedation of salmonids during loading or transport is not advised (Piper et al 1982) nor necessary. After about an hour, carbon dioxide levels reach 20-30 ppm and appear to sedate the fish.

TRANSPORT

The fish should be examined at least hourly during the trip. At each stop, dissolved oxygen and water temperature levels are checked, usually by meter. Compressed air and oxygen supplies and aeration lines also must be checked carefully. Where possible, the gauges on the air and oxygen bottles should be visible from inside the truck cab. It is also helpful if the setup allows continuous reading of dissolved oxygen and water temperature from the truck cab. The rate at which air or oxygen is delivered should be regulated to keep the water 80-100% saturated with dissolved oxygen. Using an 1125 litre transport tank, a 0.25 kg/litre loading density and at water temperatures of 4-8°C, initial air and oxygen delivery rates should be about 10 and 5 litres/min

respectively. As the fish calm down, the oxygen delivery rates can be reduced to 2 litres/min or less. Water temperature should not rise more than a few degrees over the duration of the trip.

If fish show signs of stress during an inspection, it is probably because of insufficient oxygen in the water. Unless oxygen is monitored and known to be acceptable, aeration should be improved if fish show distress. In an emergency, water should be replaced if possible, or pumped up and sprayed back by some improvised arrangement. Failing that, water can be aerated by repeatedly dipping out a pailfull and pouring it back into the tank with maximum splashing and agitation. If water temperature is too warm, some means of cooling it should be found. As commercially-available ice blocks or cubes are normally made using chlorinated water, the ice should not be added directly to the tank. Place the ice in a plastic bag or other type of leak-proof container before putting it in the tank.

In the hatchery, a continual flow of water carries away the carbon dioxide and ammonia that the fish produce in metabolism. However, these metabolites accumulate during transportation without water renewal. Aeration drives off enough of the carbon dioxide, such that dangerous amounts do not accumulate as long as the water remains well-aerated and cool. However, ammonia will continue to build up throughout the trip. Most of the ammonia ionizes, and only the un-ionized remainder is harmful to fish. Fortunately the lower the pH, the greater the proportion of ammonia that ionizes. Carbon dioxide, when dissolved in water, forms carbonic acid which lowers pH. Thus the carbon dioxide that fish produce while being transported helps keep the level of un-ionized ammonia low enough that salmonids can tolerate it, except on lengthy trips. If a long trip is contemplated, planning should include establishment of water exchange sites and procedures. Tank water should not be dumped en route where there is any change of it entering a stream course, unless it is disinfected and neutralized first.

RELEASE

Most salmonids that are transported are taken to a place where they are to be released into the natural environment. Transportation stresses salmonids and their chances of survival after release may be improved by keeping them in a net pen at the release site for some days before release. This may also help to imprint them so that they will return to that area as adults. However, it has been found that fry transported at 0.25 kg/litre with air and oxygen aeration are capable of maintaining position in velocities of 10-15 cm/sec for 24 hrs. Therefore, direct release into slow-moving areas may be equally successful.

Before unloading at a release site or at another hatchery, it was usual in the past to "temper" the tank water with water from the new environment over 20-30 min. The need for this is questionable. For some recent releases on Vancouver Island, tank oxygen levels have been matched to stream levels. This seems to reduce the jumping and erratic behaviour of release fish.

If the transfer is from fresh to salt water, some additional precautions are necessary. If juveniles are placed into saltwater too early, they will fail to grow, if not die (Kennedy 1978). The size at which successful transfer can occur varies with the species and with the degree of freshwater influence. Pink and chum salmon can be safely transferred to salinities of 10-30 ppt when they are fully buttoned-up (approximately a week after emergence); the three remaining salmon species can tolerate transfer to salt water that is less than 20 ppt at 1.5-2.0 g, but optimum size for full-strength seawater is 5 g for chinook, 8 g for yearling coho, and 35 g for yearling steelhead. (Clarke 1982; pers. comm.). Optimum size considerations, however, will be overridden by the seasonal 'window', when fish are physiologically prepared to smolt. Although fish have often been transferred abruptly from fresh to salt water without obvious detrimental impact, it is advisable to alter salinity gradually over about five days, if the capability exists to do so.

After each trip, the tank and all equipment used to handle the fish should be thoroughly cleaned and disinfected as outlined in the Preparation section.

ACKNOWLEDGEMENTS

W.A. Kennedy and W. Griffioen authored the original draft of the proposed salmonid hatchery manual for B.C.; the basic framework and excerpts for this report were taken from their draft chapter on fish transport.

We thank D.F. Alderdice for encouraging us to complete this revision. The manuscript was greatly improved through the addition of information and photos from B.W. Anderson and W.T. Foye. Thanks also go to J.D. Buxton and F.K. Sandercock for their careful review of the manuscript.

REFERENCES

Amend, D.F., T.R. Coy, B.A. Goven, K.A. Johnson, and D.H. McCarthy. 1982. Transportation of fish in closed systems: methods to control ammonia, carbon dioxide, pH, and bacterial growth. Trans. Amer. Fish. Soc. 111: 603-611.

Clarke, W.C. 1982. Evaluation of the seawater challenge test as an index of marine survival. Aquacult. 28: 177-183.

Kennedy, W.A. 1978. A handbook on rearing pan-size Pacific Salmon using floating seapens. Fish. Mar. Serv. Ind. Rept. No. 107. 111 p.

Larson, D. 1984. A new mechanism designed for helicopter fry releases. Info Memo No. 85, p. 85. In D.F. Alderdice, F.E.A. Wood, and D.W. Narver [ed.] Salmonid enhancement program--preliminary notes on new information in salmonid hatchery propogation [sic]. Can. Data Rep. Fish. Aquat. Sci. 496.

Leitritz, E., and R.C. Lewis. 1976. Trout and salmon culture (hatchery methods). Fish. Bull. 164, Calif. Dept. Fish Game. 197 p.

Lepage, R. MS 1984. A review of adult salmonid broodstock handling techniques. Draft in prep. for SEP Enhancement Operations, Dept. Fish. Oceans, Vancouver.

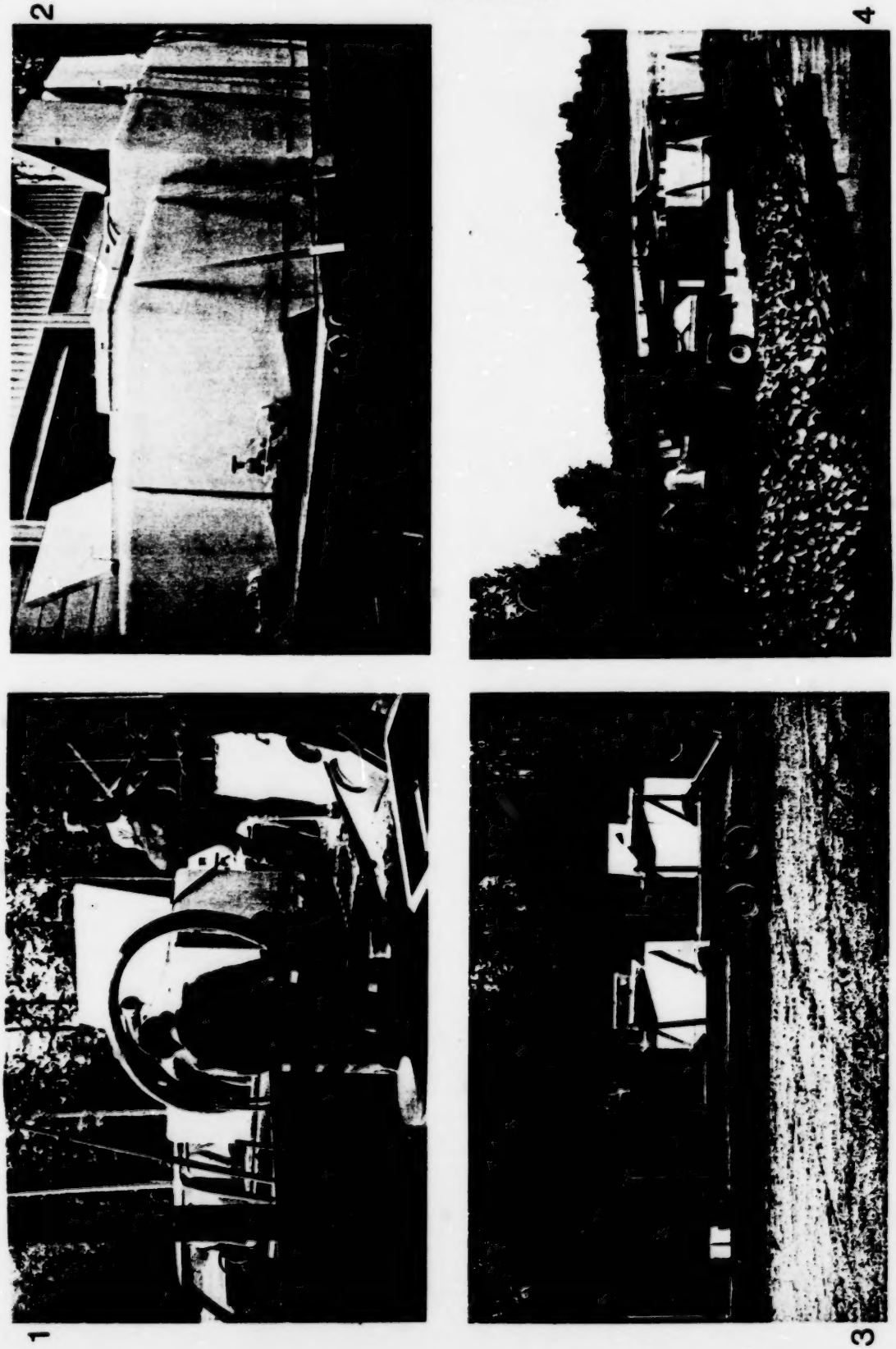
Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, and J.R. Leonard. 1982. Fish Hatchery Management. U.S. Dept. Int., Fish Wildl. Serv., Washington. 517 p.

Prince, E.E. 1984. Report of fish breeding operations in Canada, p. 225-234. In Dept. Mar. Fish., 37th Ann. Rep., Ottawa.

Shepherd, B.G., and J.G. Morris. 1987. A review of practical emergency procedures for fish culturists. Aquacult. Eng. 6(1987): 155-169.

Westers, H. 1981. Fish culture manual for the state of Michigan (Principles of intensive fish-culture). Rev. ed. Mich. Dept. Nat. Resour., Lansing, MI. 102 p + appendices.

PHOTOGRAPHS



1. Fibreglass fish transport tank installed in 3/4-ton pickup truck. Note access hatch, drain valve, and drain hose (C. MacKinnon photo).

2. Fibreglass transport tanks grouped on 5-ton flatdeck truck (W. Foye photo).

3. Side view of fibreglass transport tanks mounted on fifth-wheel gooseneck trailer (C. MacKinnon photo).

4. Release of fish from fibreglass tanks mounted on fifth-wheel gooseneck trailer (C. MacKinnon photo).

5

a

b

c

d

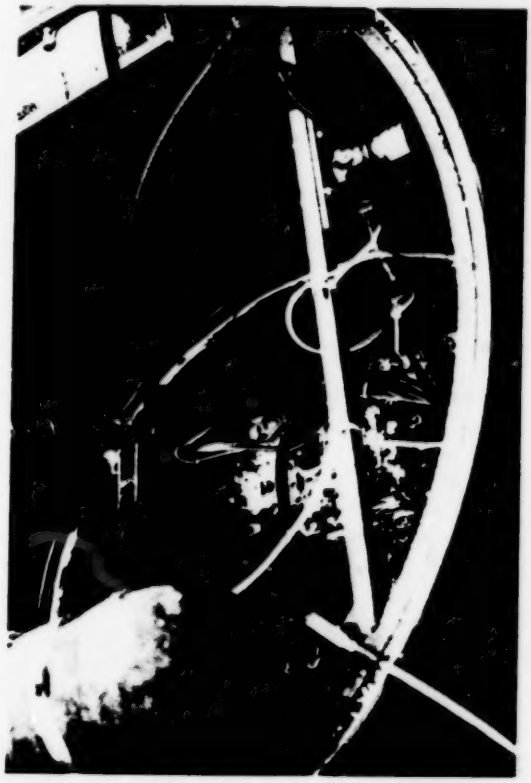
5. Photo sequence of fry transfer from truck tank to stream using Chadwick bucket

5A. Close-up of bucket. Note hinged lids, and rubber-tire bumpers to avoid damage to bucket in concrete raceways (B. Anderson photo).

5B. Hook-up of bucket (G. Bérézay photo).

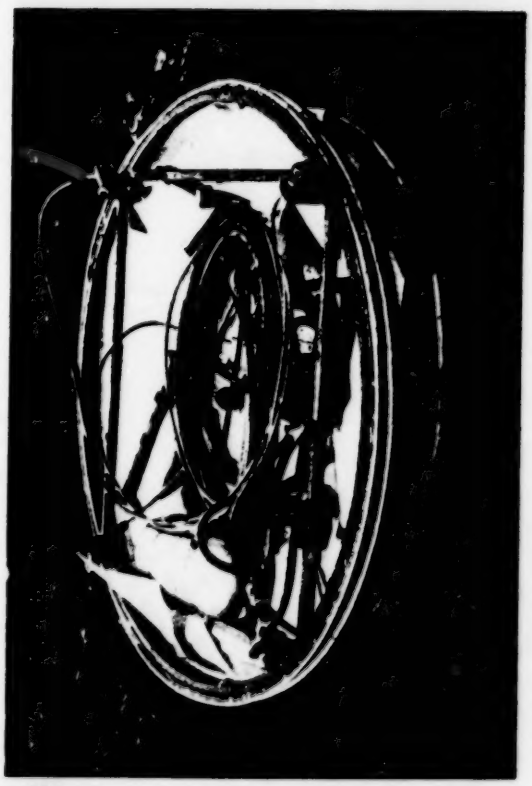
5C. Ground crew at stream with bucket (G. Bérézay photo).

5D. Bucket in stream (G. Bérézay photo).



7

9



6

8

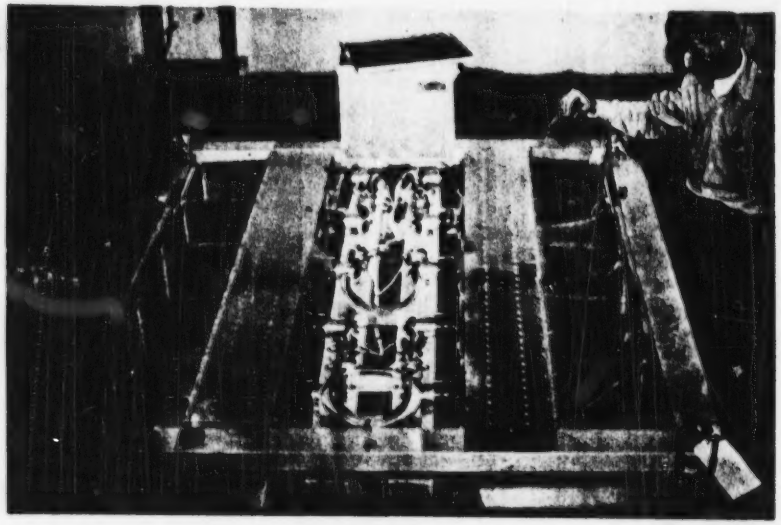
6. Hawkins-Power collapsible bucket, showing cable lifting harness; air reserve tank and hoses are part of the solenoid-operated remote release mechanism (B. Anderson photo).

7. Interior view of Hawkins-Power bucket with solenoid door-release mechanism and aeration system in place. Tank on left is for aeration; tank on right provides air reserve to operate door release (B. Anderson photo).

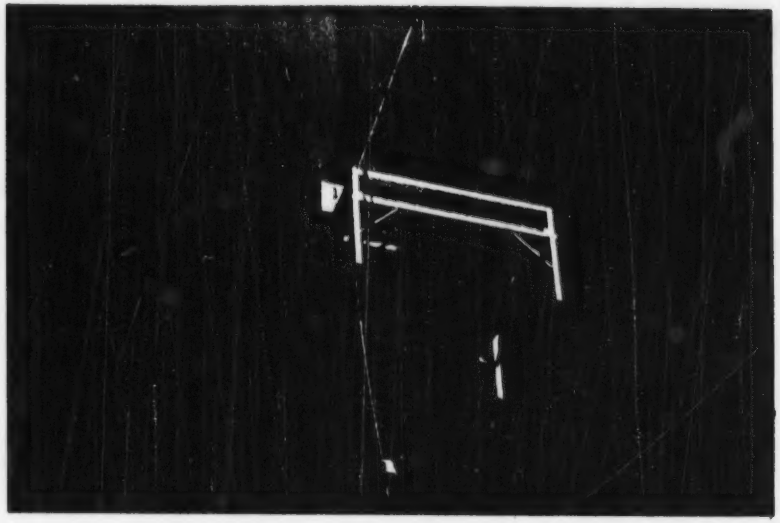
8. Griffith polymer bucket being dumped manually at Conuma hatchery (B. Anderson photo).

9. Transport of adult salmon using two-man stretcher (G. Bérézay photo).

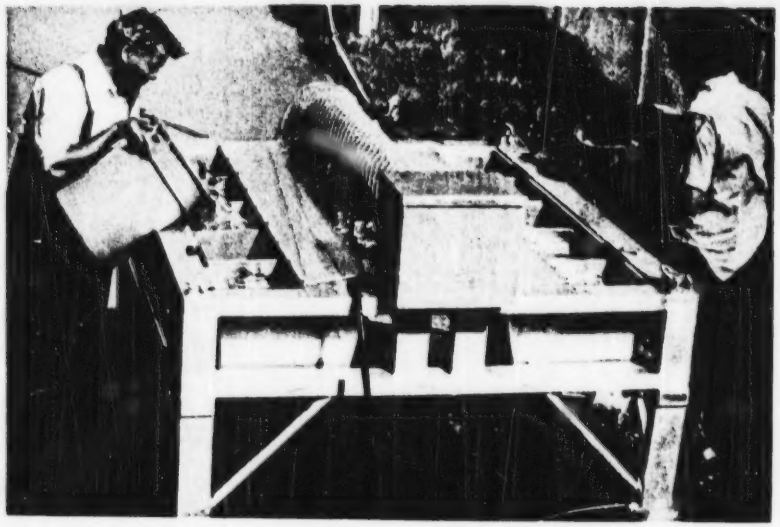
a



b



c



d

10. The B.C. Ministry of Environment's container used for helicopter release of fry

10A. BCMOE employee lifting plexiglas cover on unit. Note battery box at rear of unit, and the 10 solenoid switches along the length of the center beams (containers dump to center of table). (D. Larsen photo).

10B. Unit being lifted by helicopter. Note legs, solenoid control cable, and 'early warning' lowering marker on rope beneath unit (J. Van Tine photo).

10C. Loading fish into unit. Note compressed gas tank now strapped to center beams, covered by protective shroud (J. Van Tine photo).

10D. Close-up of unit during loading (J. Van Tine photo)

11

12

a

b

13

11. Fish-pump being used to load steelhead from earthen rearing channel at Chilliwack Hatchery (B. Shepherd photo).

12. Use of crowder screen in raceway (G. Pérézay photo).

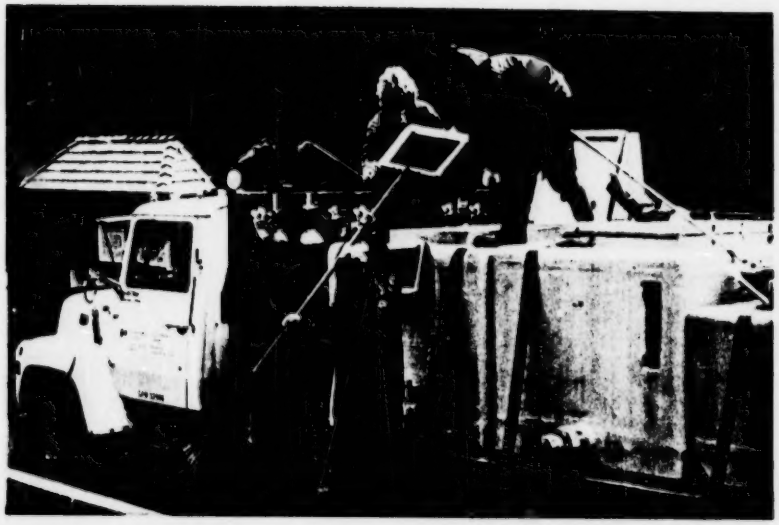
13. Use of flume for release of adult chum salmon at Inch Creek Hatchery (P. Larsen photos).

13A. View of vehicle and tank set-up at start of release

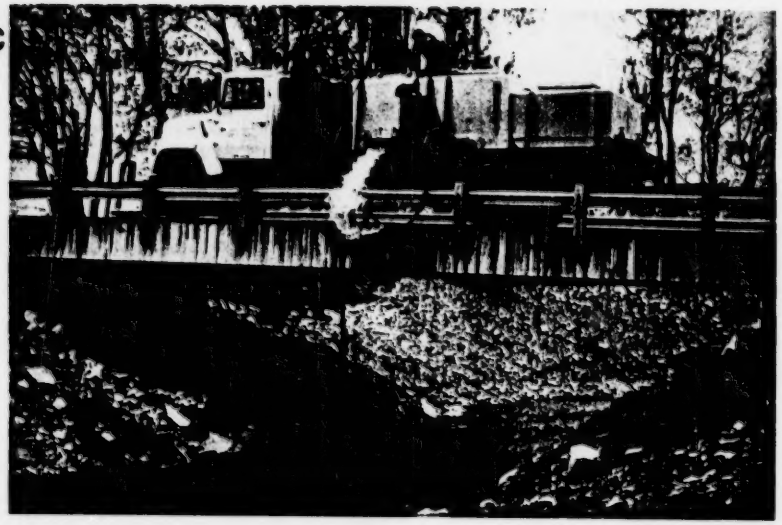
13B. Close-up of flume (note dual-purpose valves on tanks) at end of release

a

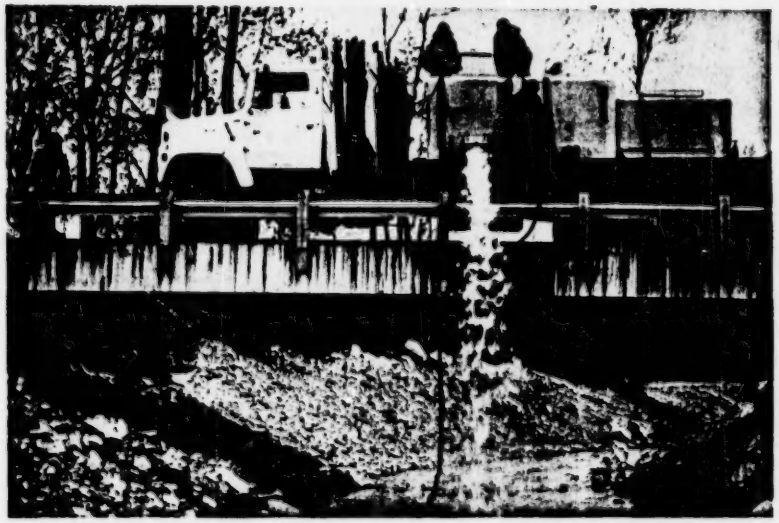
b



c



d



14. Sequence showing manual loading and release of juvenile fish by Inch Creek Hatchery staff.

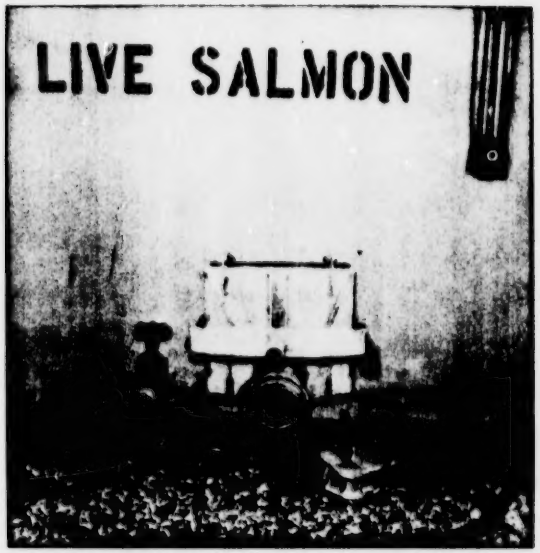
14A. Manual loading of juveniles at hatchery. Note use of temporary walkways, 'chain gang' and multiple dipnets in order to minimize loading time (P. Larsen photo).

14B. Per Photo 14A.

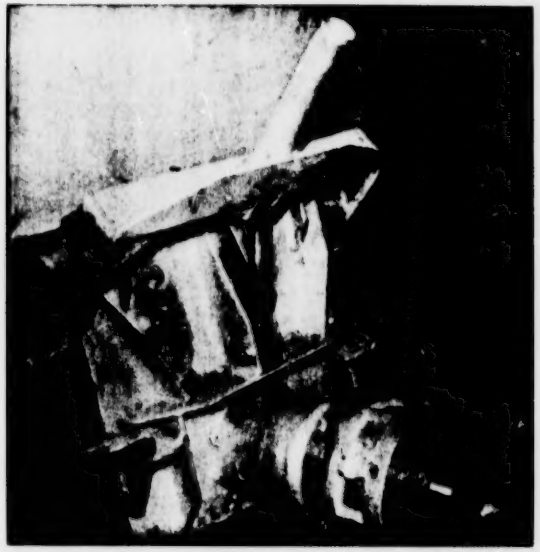
14C. Start of release of juveniles from road bridge. In this case, juveniles were allowed to free-fall into creek and a portable pump was used to flush all fish from the tank (G. Dixon photo).

14D. Release underway. Note rack of compressed air and oxygen tanks, and also truck-mounted crane used to lift empty tanks on and off truck (G. Dixon photo).

a



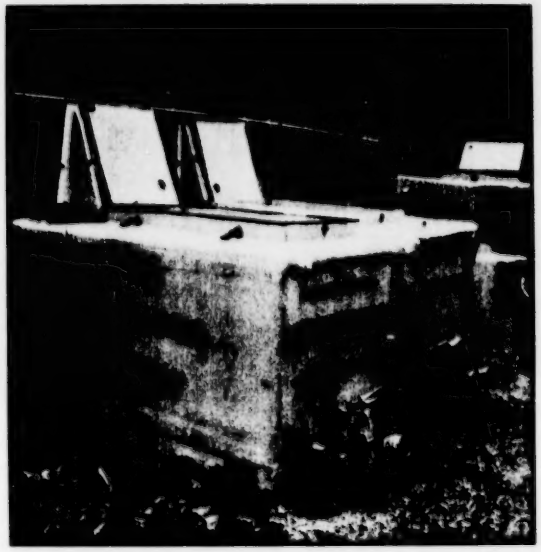
b



15

c

d



15. Details of dual-purpose valve and tank set-up (B. Donas photos).

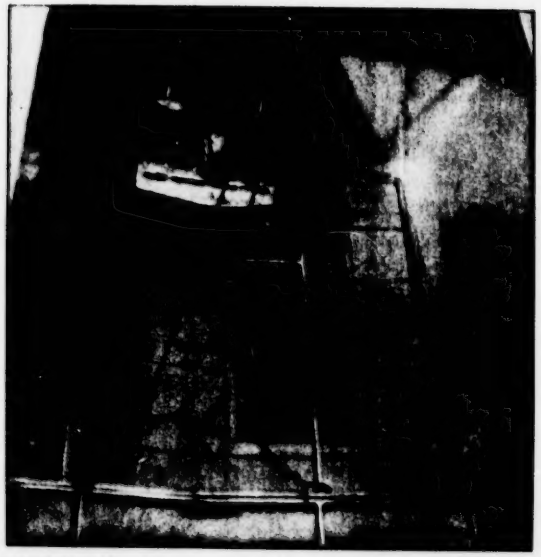
15A. 30 x 30 cm outlet gate with built-in 10 cm diameter coupling. Note 5 cm water drainage/exchange valve to left of gate, and water level indicator tube (valved) at upper right.

15B. Close-up of 30 x 30 cm quick-release, self-locking sealing outlet gate in partially-open position.

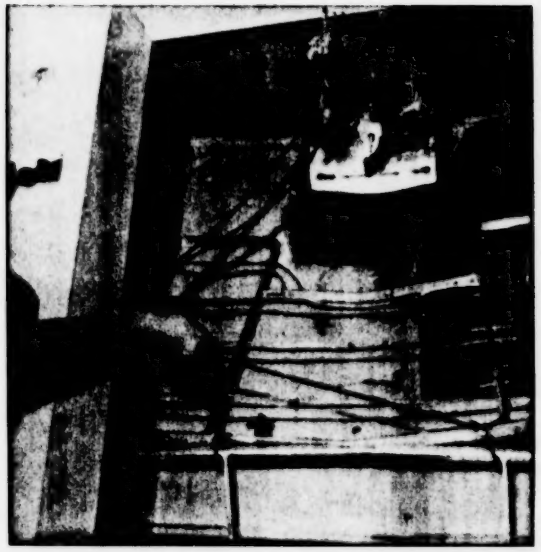
15C. 30 x 30 cm outlet gate in fully-open position

15D. Adult/juvenile fibreglass tanks with dual-purpose gates. Note two approaches to lids for large openings. Tank at back of photo has earlier single lid hinged along length; tanks at front have double lids hinged at middle and at one end (improves access from either side). Also note lid tie-downs.

e



f



15

15E. Interior view of tank with dual-purpose release outlet. Note two-piece aeration frame which supports perforated tubing, and hinged inner discharge safety gate with pull ropes attached. Aeration frame is covered with perforated aluminum plate during transport of adults.

15F. Demonstration as to how aeration frame is raised using pull rope during release of juveniles. Screened sump to right of discharge safety gate is for water drainage/exchange valve.

APPENDIX

DATE: MAY 7 1987

TO: STOCK ENHANCEMENT OFFICERS

FROM : BILL FOYE, INCH CREEK HATCHERY

RE: TRANSPORT OF LIVE FISH ON BC ROADWAYS AND BC FERRIES

At the Inch Creek Hatchery, we transport up to 9.5 million chum and coho juvenile annually. Transport is accomplished via 5 ton truck and or P/U truck. Compressed air/oxygen are bubbled into the tanks through regulators as a means of fish life suppport. On occasion, we have used the Albion/Langley short run Ferry as part of our transport route. They usually request that we take our regulators off the tanks and cap the compressed air and oxygen tanks. This means the life support system to the fish is discontinued for a period of time.

In an effort to eliminate this problem we contacted the Department of Highways, the Motor Vehicle Branch and the BC Ferry Corporation to become familiar with the Rules and Regulations of carrying compressed air and oxygen. The following is a summary of whom we contacted:

1. Ben Nicholson or John Philips in Victoria /Motor Vehicle Department @ 387 5585 or 387 3142 - Highway Travel and Short Run Ferries

2. Jerry Barber : Tsawwassen Ferry Administration 943 9331

3. Captain Wheelan @ 921 7414 Ferry travel

Rules and Regulations for running compressed air and oxygen into transport tanks during live fish transport:

On highways or other roadways we are exempt under section 2.25 of the Dangerous Goods Act and are allowed to carry compressed air and oxygen with guages running. We are transporting LIVE FISH. The cylinders are on the truck as an aside to the fish transport. We can carry up to 500 Kgs of 02 without any permits.

Transport on short run ferries such as the Albion/ Langley Ferry is not a problem; under the International Maritime Code, we can travel on these Ferries without any permits or letters of permission, with guages running.

For travel on BC Ferries, we have acquired a letter of permission from the BC Ferry Corporation. A copy of this letter should be carried on all trucks transporting fish and

should be presented at the toll booth. Please find enclosed a copy of this letter, for your information. We have highlighted the section we feel are pertinent. You would be advised to carry caps for all cylinders as you may be required to put them on if you have no fish in your transport tanks.

We hope that the above information will assist you when inquiring about fish transport using compressed air and compressed oxygen. If you have any questions, please call us at 826 0244.

W.T. Foye, S.E.O.
Inch Creek Hatchery

enc. 3
cc: G. Berezay
D. Harding
C. MacKinnon

Province of
British Columbia

Ministry of
Transportation
and Highways

- 31 -

Superintendent of Motor Vehicles
Motor Vehicle Department
Victoria
British Columbia
V8T 5A3
Telephone: (604) 387- 5585

IN REPLY QUOTE FILE No. 3015 YOUR FILE No.

PLEASE MARK FOR ATTENTION OF
Superintendent's Office
DIVISION

April 29, 1987

RECEIVED
MAY 5 - 1987

Mr. William T. Foye
Stock Enhancement Officer
Box 61
38620 Bell Road
Dewdney, B.C.
V0M 1H0

Dear Mr. Foye:

Re: Transport of Dangerous Goods - Oxygen and Compressed Air

I have enclosed copies of Sections of Part II as they may apply to your operation (Part 2.25 and Part 2.31(b)(1)). Part 2.31(b)(1) limits the number of cylinders to five. As I understand it, you transport more than that, so this section would not always apply. Part 2.25 refers to containers designed to perform functions other than to solely contain the dangerous goods.

The need to remove the regulators or gauges may be a requirement of the B.C. Ferry Corporation and I suggest that you contact Mr. Gerry Barber at the Tsawwassen Terminal for further information.

Should you wish additional information, please do not hesitate to contact this office.

Yours truly,

J.F. Phillips
Dangerous Goods Coordinator
Motor Vehicle Department

Attachment

JFP/ca

if the consignor of the dangerous goods complies with the requirements for classification and documentation, and the label and packing specifications, of the ICAO Technical Instructions and the road vehicle used for the transportation of the dangerous goods is placarded in accordance with Part V.

(3) Subsections (1) and (2) do not apply to dangerous goods that are

(a) compressed gases, other than compressed gases in cylinders that comply with section 73.34 and Subpart F of the *Regulations for the Transportation of Dangerous Commodities by Rail*; or

(b) radioactive materials.

2.25 These Regulations do not apply to the handling, offering for transport or transporting by road of dangerous goods that are contained in, and are not intended to be discharged from, an instrument or a piece of equipment that

(a) is not dangerous goods, and

(b) is designed to perform a function other than solely to contain dangerous goods,

if the dangerous goods contained in that instrument or piece of equipment are in quantities not greater than the quantities specified for the dangerous goods in Schedule VIII

2.26 Parts IV and VI to VIII and sections 9.2 to 9.7 do not apply to the handling, offering for transport or transporting by road of dangerous goods in quantities for which a placard is not required in Part V and that are transported solely in a road vehicle licensed as a farm vehicle between a farm and a place where the goods will be used, if the travelling distance from the farm to the place is not more than 50 km.

2.27 Parts IV to VI do not apply to the handling, offering for transport or transporting of dangerous goods by road

(a) by or for a manufacturer of the dangerous goods between two properties owned or leased by the manufacturer, or

(b) by or for a user of the dangerous goods between two properties owned or leased by the user,

if

(c) the dangerous goods are transported not more than 1 km on a public road;

(d) the local authority is informed of the movement referred to in paragraph (c) and the nature of the dangerous goods; and

(e) the person in charge of the vehicle transporting the dangerous goods displays on the vehicle a placard that corresponds to the placard set out as Figure 19 in Part II of Schedule V.

2.28 Parts III to IX do not apply to the handling, offering for transport or transporting of dangerous goods by road

(a) in a service truck that is carrying dangerous goods in quantities that do not exceed the quantities normally required for an emergency or for repairs; or

(b) in a vehicle employed in constructing, repairing, painting or marking the road surface.

2.29 (1) Subject to subsection (2), Parts III and VI to XIII do not apply to the handling, offering for transport or transporting by road of a consignment of 2,000 kg net or less of new explosives that are to be tested if

(a) the vehicle used to transport the dangerous goods is travelling solely on land, other than on a railway vehicle, between a licensed factory, as defined in section 2 of the *Explosives Act*, and a testing site;

(b) where the mass of the consignment of new explosives exceeds 250 kg net, the manufacturer of the new explosives notifies in writing the Director General at least one week before the dangerous goods are transported of the movement and the nature of the dangerous goods;

(c) the manufacturer displays on the vehicle transporting the explosives a placard set out as Figure 1 in Part II of Schedule V without the division number or compatibility group of the new explosives; and

(d) a shipping document that includes the quantity of the new explosives and the type of explosion hazard accompanies the consignment.

(2) Parts III to XIII do not apply to the handling, offering for transport or transporting by road of a consignment of 250 kg net or less of new explosives that are to be tested if

(a) the vehicle used to transport the dangerous goods is travelling solely on land, other than on a railway vehicle, between a licensed factory, as defined in section 2 of the *Explosives Act*, and a testing site;

(b) the manufacturer displays on the vehicle transporting the explosives a placard set out as Figure 1 in Part II of Schedule V without the division number or compatibility group of the new explosives; and

(c) a shipping document that includes the quantity of the new explosives and the type of explosion hazard accompanies the consignment.

2.29.1 Subject to Part IX, these Regulations do not apply to the handling, offering for transport or transporting of samples of explosives solely by a road vehicle if

(a) the quantity of the samples does not exceed

(i) 25 kg net explosives quantity, or

(ii) where the explosives are contained in an article, not more than 50 articles;

(b) the samples are constantly in the custody and control of the owner of the explosives or his agent;

(c) no other dangerous goods are carried as cargo on or in the vehicle; and

(d) the road vehicle is not a public passenger road vehicle.

2.30 Parts VI to VIII and X to XIII do not apply to the handling, offering for transport or transporting by road of a consignment of fire extinguishers that

(a) do not contain a product or substance that has a primary classification of Class 8 Division 3 of Class 2 or Division 1 of Class 6;

(b) are contained in an outer packaging;

(c) have an internal volume

(i) of less than 18 L, or

(ii) where the fire extinguishers contain liquified gas, of less than 0.6 L;

(d) have a service pressure not greater than 1,650 kPa at 21°C;

(e) are constructed, maintained, marked and charged in accordance with

(i) ULC Standard S 504 dated February 1977,

(ii) ULC Standard S 507 dated April 1976, or

(iii) ULC Standard S 512 dated January 1977; and

(f) are inspected, retested and maintained in accordance with section 6.2 of the NFCC.

2.31 Part IV, sections 5.16 to 5.33 and Part IX, except sections 9.10, 9.13 and 9.14, do not apply to the transporting solely by road of

(a) gasoline if

(i) the gasoline is transported in one or more containers,

(ii) each container is transported in an open vehicle so that the label or placard displayed on the container is visible from outside the vehicle,

(iii) each container is secured to the vehicle during transport, and

(iv) the total capacity of containers in or on the vehicle, excluding the volume of the gasoline used for the propulsion of the vehicle, is not more than 2 000 L;

(b) propane, acetylene, oxygen or mixtures of methyl acetylene and propadiene if

(i) the dangerous goods are

(A) in a total quantity not greater than 500 kg gross mass, or

(B) contained in not more than 5 cylinders,

(ii) the container or the cylinder that contains the dangerous goods is transported in an open vehicle so that the label displayed on the container or the cylinder is visible from outside the vehicle, and

(iii) the container or the cylinder is secured in or on the vehicle during transport; and

(c) herbicides, solutions of herbicides, pesticides or solutions of pesticides if

(i) the product or solution is transported in a tank that has a total volume of 5,000 L or less,

(ii) the tank is being used for the mixing or holding of the product or solution, prior to or during application procedures, and

(iii) the tank is placarded in accordance with Part V but without the product identification number.

2.32 (1) Subject to subsections (2) and (3), Part IV does not apply to the handling, offering for transport or transporting solely by road of

(a) gasoline or propane if the total volume in or on any one vehicle is 17 000 L or less;

(b) ammonium nitrate fertilizer with product identification number 2071 in a quantity of 13.6 tonnes or less;

(c) anhydrous ammonia if

(i) it is transported in a tank that may be used for the field application of the product, and

(ii) the tank has a water capacity of 10,000 L or less.

(2) A consignment of the dangerous goods referred to in paragraph (1)(a) shall be accompanied by a record sheet that indicates the shipping name, the total quantity of the goods loaded before delivery and the quantity of the goods subtracted from the total at each delivery.

(3) A consignment of the dangerous goods referred to in paragraph (1)(b) shall be accompanied by a shipping document that indicates the shipping name, the product identification number and the total quantity of the goods.

2.32.1 Sections 7.15 to 7.19 do not apply in respect of anhydrous ammonia referred to in paragraph 2.32(1)(c).

PROHIBITION

2.33 No person shall handle, offer for transport or transport dangerous goods in a means of transport where the dangerous goods

(a) are explosives in bulk except where the explosives are to be transported by road in accordance with List I of Schedule II;

British Columbia Ferry Corporation

Horseshoe Bay Terminal, 6750 Keith Road, West Vancouver, B.C. V7W 2V1

April 28, 1987
File: HBO 2100-2

Mr. William Foye
Inch Creek Hatchery
Box 61 - 38620 Bell Road
Dewdney, B.C.
V0M 1H0

Dear Mr. Foye:

Subject: Live Fish

This will confirm that it is permissible for you to transport live fish aboard B.C. Ferries. Please feel free to use this letter as authorization if needed at the toll booths.

Yours truly,

Capt. T.J. Whelan
Manager Operations (C)
Horseshoe Bay

TJW:gt

cc: Mr. F.W. Ramsay
Capt. C.H. Partridge
Mr. G.W. Barber
Mr. K.L. Johnson
Mr. O.I. Kandall
Mr. J.C. Yates